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GROUND SURFACE SPIDER FAUNA IN FLORIDA SANDHILL COMMUNITIES

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ABSTRACT. Spiders were collected from the forest floor surface using pitfall traps (cans and buckets) and funnel traps at 12 study sites selected to represent the sandhill community of north and central Florida. A total of 5236 spiders was collected, which included 23 families, 92 genera, and 154 species. The largest number of individuals (528) was collected at Orange City and the largest number of species (48) was collected at the most northern site, Suwannee River State Park. Species richness, abundance, similarity and seasonal variation were compared among the study sites. Lycosidae comprised 75.2% of the total number of spiders collected. Four species were collected at all 12 sites: the lycosids *Lycosa ammophila, Schizocosa duplex,* and *S. segregata,* and the salticid *Habrocestum xerophilum.* Eighty-three (53.9%) of the 154 species were collected at only one site.

In the past, sandhills of the southeastern coastal plain of North America supported an ecosystem type variously referenced as "high pine land" (Harper 1927), "sandhill country" (Wells & Shunk 1931), or "longleaf pine-turkey oak sandhills" (Laessle 1942). Laessle (1958), Myers (1985, 1990) and Stout & Marion (1993) provided a general summary of this xeric upland community type (Fig. 1). The tree layer is dominated by longleaf pine, *Pinus palustris* Mill. and turkey oak, *Quercus laevis* Walt. The understory consists chiefly of wiregrass, *Aristida stricta* Michx. and a rich assemblage of other grasses and herbs (Platt et al. 1988).

Examples of this abstract community type are found from eastern Virginia to extreme eastern Texas and peninsular Florida (Stout and Marion 1993). Development and fragmentation of the community began over 200 years ago and continues to this day as remnant stands are converted to housing developments and shopping malls. Approximately 20% of the historic landscape of Florida was occupied by the sandhill community, but nearly 90% of this community has been lost in the last 50 years (Cox et al. 1994). The loss of biodiversity associated with landscape development has been documented by Burgess & Sharpe (1981), Wilcove et al. (1986), Whitcomb (1987) and Saunders et al. (1991).

In order to study the loss of biodiversity in the Florida sandhill communities, we thought it necessary to obtain knowledge of the existing fauna. We were able to sample 12 different sites in peninsular Florida, using a variety of sampling techniques in order to maximize the number of species of ground fauna collected. One of the major groups of organisms collected was the spiders.

The biodiversity of arachnids associated with the forest floor of xeric pineland communities of Florida is poorly known. Corey & Stout (1990, 1992) reported on the scorpion, pseudoscorpion, opilionid, uropygid, solpugid, mite, tick, centipede and millipede faunas in sandhill communities. Corey & Taylor (1987, 1988, 1989) reported on the scorpion, pseudoscorpion, opilionid and spider faunas in pond pine, sand pine scrub and pine flatwoods communities of Florida. Lowrie reported on spiders from the Pensacola area of Florida (1963, 1971). Muma (1973, 1975) sampled the ground surface spider fauna in four central

Figure 1.—Typical sandhill community vegetation (late winter, Levy County, Florida).

Florida communities (pine flatwoods, sand pine dune, citrus groves, residential). Rey & McCoy (1983) studied the spiders and pseudoscorpions in northwest Florida salt marshes. The purpose of this paper is to document the species composition, diversity, guild composition and seasonal abundance of spiders associated with the forest floor of longleaf pine-turkey oak sandhill communities of peninsular Florida. Our approach is similar to that of Barnes & Barnes (1955) in that we are considering an abstract community type with a wide geographic range. In another paper, we will discuss the effects of area and isolation on species richness of forest floor arthropods in these xeric pinelands.

METHODS

Study sites.—The ground fauna of twelve sandhill sites was sampled between November 1986 and December 1988 (Fig. 2). Study site selection was subjective and depended on several attributes: 1) internal consistency of vegetative cover (tree, shrub and ground layer), 2) nature of the surrounding habitat, 3) area, 4) security from disturbance, and 5) accessibility. Each study site was sampled for four days during each of four periods: September-November (= autumn), December-February (= winter), March-May (= spring) and June-August (= summer).

Sampling locations included: San Felasco Hammock (SF) and Morningside Nature Center (MS), Alachua County; Spruce Creek Preserve (SC) and Orange City (OC), Volusia County; Bok Tower Gardens (BT), Polk County; O'leno State Park (OL), Columbia County; Suwannee River State Park (SR), Suwannee County; Wekiwa Springs State Park (WS), Orange County; Sandhill Boy Scout Reservation (BS) and Janet Butterfield Brooks Preserve (JB), Hernando County; Interlachen (IL), Putnam County; Starkey Well Field Area (SW), Pasco County.

Sampling.—Spiders were collected using three different techniques. Five pitfall traps with a diameter of 15.5 cm (3.79-liter tin can) were randomly placed (Post & Riechert 1977) in each study site during the first collecting period. During subsequent collections the traps were placed in the same location as in the first collecting period. Cans were buried flush with the soil surface and partly filled

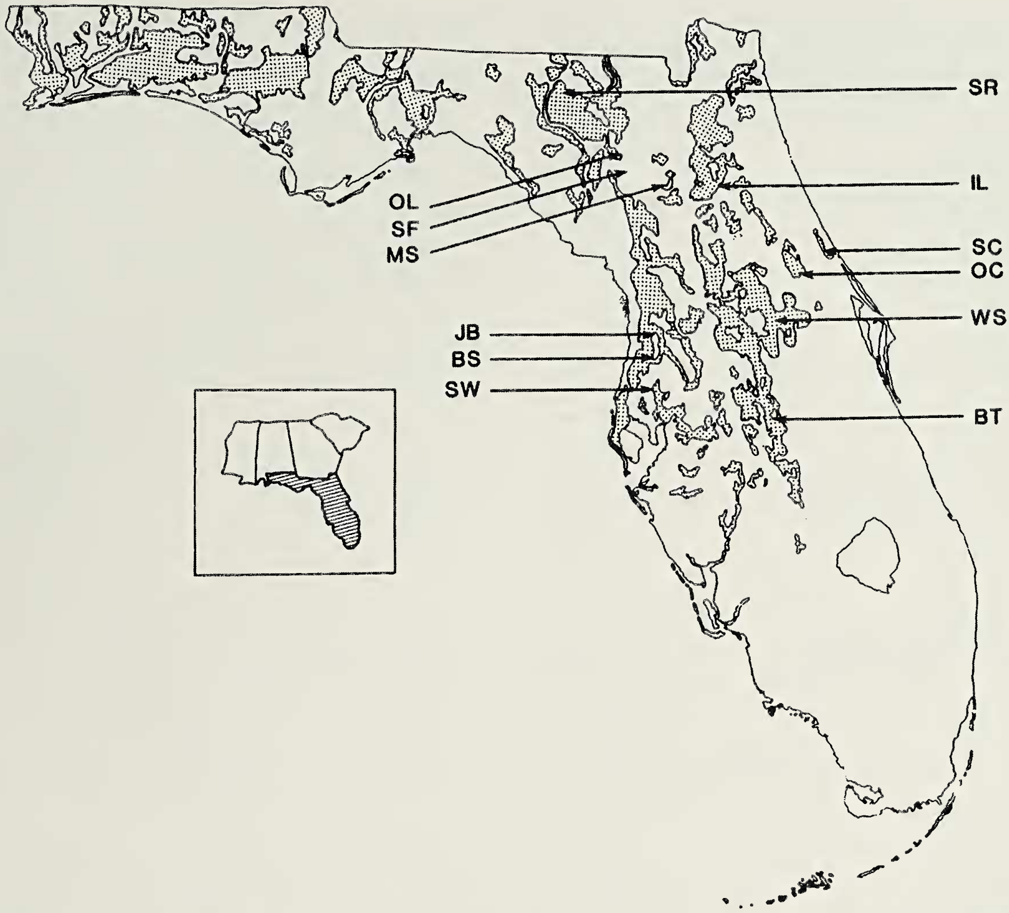

Figure 2.—Sandhill study site locations in Florida. Sampling locations are: Suwannee River State Park (SR), O'leno State Park (OL), San Felasco Hammock (SF), Morningside Nature Center (MS), Interlachen (IL), Spruce Creek Preserve (SC), Orange City (OC), Wekiwa Springs State Park (WS), Janet Butterfield Brooks Preserve (JB), Sandhill Boy Scout Reservation (BS), Starkey Well Field Area (SW), Bok Tower Gardens (BT). Sandhill distributions (stippled) are based on Davis (1980) and do not reflect minor sites of this community due to the scale of the illustration.

with 0.47 liter of a mixture of 2 parts ethylene glycol, 1 part water and 1 part 95% ethanol. A slightly elevated wooden cover protected each trap from disturbance. A similar but more complex technique designed to capture herpetofauna ("herp arrays") consisted of 16 buckets and 16 funnel traps associated with drift fences (Campbell & Christman 1982). Each of two arrays per site consisted of four sheet metal arms (7.6 m long) oriented in the cardinal directions. A pitfall trap with a diameter of 29.0 cm (21.4 liter plastic bucket) was buried flush with the surface at the end of each arm (2 per arm). No preservative was added to the buckets. Funnel traps (10 × 100 cm) made of fine-mesh wire window screening were placed on the ground on each side of a drift fence arm at the midpoint. Spiders were removed from the buckets and funnel traps daily and preserved in ethanol. A total of 95 samples was taken; SW was sampled on seven rather than eight occasions.

Identification.—Adult spiders were identified to the lowest possible taxon. Most immatures were identified to family only. Voucher specimens have been deposited in the Florida State Collection of Arthropods.

Habitat analysis.—Tree, shrub, and herbaceous vegetation was sampled to determine if the abundance of spiders was correlated with these habitat features. Internal site homogeneity allowed us to use a completely ran-

Table 1.—Spider abundance collected in Florida sandhills using pitfall traps (P), buckets (B), and funnel traps (F). See text for study site abbreviations.

Species	Method	Collection Sites	Totals
Ctenizidae			2
Myrmeciophila sp.	P, B	MS, BT, OL, SW	13
Ummidia audouini (Lucas)	B	WS	1
Ummidia sp. #1	B	SF, OL, JB	9
Ummidia sp. #2	B	SF, OL	4
Ummidia sp. #3	B	OC, SC, WS, OL, IN, JB	21
Totals			50
Uloboridae			2
Uloborus glomosus (Walck.)	P, B	MS, JB, SW	4
Totals			6
Dictynidae			1
Dictyna formidolosa G&I	B	OC	1
Lathys immaculata C&I	B	OL	1
Lathys albida Gertsch	P	SC	1
Lathys sp.	B	SC	1
Totals			5
Amaurobiidae			4
Metaltella simoni (Keys.)	B	MS, SR, BT	20
Titanoeca brunnea Emerton	P, B	OC, MS, SR, IN, SW	7
Totals			31
Oonopidae			
Heteroonops spinimanus (Simon)	B	SF	1
Totals			1
Deinopidae			
Deinopis spinosa Marx	B	MS	1
Totals			1
Theridiidae			20
Achaearanea porteri (Banks)	P, B, F	SC, MS, WS, OL, IN, JB, BS	26
Coleosoma acutiventer (Keys.)	B	MS	1
Crustulina altera G&A	B	OC	2
Dipoena abdita G&M	P	SR	1
D. nigra (Emerton)	P	SR, BS	2
Euryopis funebris (Hentz)	P	SR	1
Lactrodectus mactans (Fabr.)	P, B	SC, MS, IN, JB, BS, SW	14
L. geometricus CL Koch	B	SR, BT, BS	5
Pholcomma hirsutum Emerton	P	SC	1
Steatoda quadrimaculata (OPC)	B	SR	1
Stemmops bicolor OPC	P	WS, OL	2
Theridion cinctipes Banks	P	SR	1
Tidarren sisyphoides (Walck.)	B	SF	1
Totals			78
Linyphiidae			58
Centromerus tennapax (Barrows)	P, B	OC, OL	2
Ceratinops crenata Emerton	P	BS	1
Ceratinopsis sp.	P	SW	1
Eperigone maculata (Banks)	P	OC, SC, MS, SR, JB, SW	15
Erigone autumnalis Emerton	P	JB	1
Frontinella pyramitela (Walck.)	B	JB	1
Grammonota texana (Banks)	B	OL	1
Tapinocyba hortensis (Emerton)	P	MS, SW	2
Tennesseellum formicum (Emerton)	P	OL	1
Meioneta unimaculata (Banks)	P	OC, SF, MS, SR, OL, JB	9

Table 1.—Continued.

Species	Method	Collection Sites	Totals
Meioneta sp. #1	P	OC	1
Meioneta sp. #2	P, B	SF, MS, IN	3
Meioneta sp. #3	P	SF	2
Meioneta sp. #4	P	SC	1
Meioneta sp. #5	P	BS	1
Meioneta sp. #6	P	BS	1
Species #1	P	JB	1
Species #2	P	IN	1
Species #3	P	SR	2
Species #4	B	JB	2
Species #5	B	SC	1
Species #6	P	SC	1
Species #7	P	MS	1
Species #8	P	WS	1
Species #9	B	OL	1
Species #10	P	OL	2
Totals			114
Araneidae			9
Acacesia hamata (Hentz)	P	MS	1
Acanthepeira stellata (Marx)	P, F	OL, JB	2
Argiope aurantia Lucas	B	WS	1
Eustala anastera (Walck.)	P	SR	1
Hypsosinga rubens (Hentz)	B	OC	1
Micrathena gracilis (Marx)	B	OL	1
Wagneriana tauricornis (OPC)	P	WS, OL	2
Totals			18
Agelenidae			1
Agelenopsis barrowsi (Gertsch)	B, F	SF, MS, IN, JB, BS	23
Circurina varians G&M	P, B	OC	5
Totals			29
Hahniidae			1
Hahnia cinerea Emerton	P, B	OC, SR, JB, BS	13
Neoantistea agilis (Keys.)	P, B	SR, OL	3
Totals			17
Mimetidae			
Ero pensacolae Ivie & Barrows	B	SR	1
Totals			1
Lycosidae			1148
Arctosa incerta Bryant	P, B	OC, WS, SR, OL	16
A. littoralis (Hentz)	P, B	SF, MS, WS, BT, OL, JB, SW	81
Geolycosa fatifera (Hentz)	B	IN	1
G. patellonigra Wallace	B	SF, WS	2
G. xera McCrone	B	OC, MS, BT, JB, SW	21
Gladicosa pulchra (Keys.)	P, B, F	OC, SC, SF, MS, WS, BT, OL, IN, BS	37
Lycosa ammophila Wallace	P, B, F	OS, SC, SF, MS, WS, SR, BT, OL, IN, JB, BS, SW	1555
L. carolinensis Walck.	P, B	OC, SC, MS, SR, OL, IN, JB, BS, SW	106
L. lenta Hentz	B	SW	1
L. osceola G&W	B	SC, SF, BS	20
Pardosa milvina (Hentz)	B, F	SF, SR, IN	13
P. parvula Banks	P	SR	2
Pirata spiniger (Simon)	P, B	MS, SR, OL, JB	9

Table 1.—Continued.

Species	Method	Collection Sites	Totals
Rabidosa punctulata (Hentz)	B, F	SC, BT, IN, BS, SW	24
R. rabida (Walck.)	B	SC, SR, BT, JB, BS	12
Schizocosa duplex Chamberlin	P, B, F	OC, SC, SF, MS, WS, SR, BT, OL, IN, JB, BS, SW	711
S. avida (Walck.)	P, B, F	OC, MS, BT, SW	11
S. segregata G&W	P, B, F	OC, SC, SF, MS, WS, SR, BT, OL, IN, JB, BS, SW	74
Sosippus floridanus Simon	P, B, F	OC, SF, MS, WS, BT, OL, JB, BS, SW	93
S. mimus Chamberlin	F	SR	1
Trochosa parthenus (Chamberlin)	P	SR	1
Totals			3939
Oxyopidae			22
Hamataliwa grisea Keys.	B	OC	1
Oxyopes acleistus Chamberlin	B	BT, OL, SW	3
Peucetia viridans (Hentz)	B	BT	1
Totals			26
Gnaphosidae			54
Callilepis imbecilla (Keys.)	P, B	OC, SC, MS, WS, SR, BT, OL, IN	24
Cesonia bilineata (Hentz)	P	BT	5
Drassyllus aprilinus (Banks)	P, B, F	SC, SF, MS, WS, BT, IN, BS, SW	44
D. seminolus C&G	P	SF	1
D. alachua P&S	P	SF	1
D. eremitus Chamberlin	P	SR	1
D. lepidus (Banks)	B	MS	3
Gnaphosa sericata (L. Koch)	P, B	OC, SR, BT	3
Herpyllus emertoni Bryant	P	SC	1
Haplodrassus signifer (CL Koch)	P, B	OC, SC, SF, WS, SR, BT, IN, BS	37
Litopyllus temporarius Chamberlin	P	SF	1
Micaria punctata Banks	P	MS	1
M. seminola Gertsch	P	OC	2
Sergiolus capulatus (Walck.)	B	WS	1
S. cyaneiventris Simon	P	SW	1
Talanites exilineae (P&S)	P, B	OC, SF, MS, WS, SR, BT, OL, IN, BS, SW	37
Zelotes hentzi Barrows	B	BT	10
Z. pseustes Chamberlin	P, B	OC, SC, SF, SR, IN, JB, BS	54
Z. lymnophilus Chamberlin	P, B	OC, SFMS, WS, BT, OL, IN, SW	42
Z. ocala P&S	P	OC, IN	4
Z. florodes P&S	P	BT	1
Totals			328
Clubionidae			21
Castianeira amoena (CL Koch)	P	SR	2
C. descripta (Hentz)	P, B	OC, SC, SF, MS, WS, SR, BT, IN, JB, BS, SW	39
C. longipalpus (Hentz)	P, B	MS, SR, IN	4
C. cingulata (CL Koch)	B	OC, SC, JB, BS	5
C. crocata (Hentz)	B	OL, SW	2
C. floridana (Banks)	P	MS, SR, OL, JB, SW	8
C. gertschi Kaston	P	WS	1

Table 1.—Continued.

Species	Method	Collection Sites	Totals
Clubiona pikei Gertsch	B	SR, OL	2
Elaver excepta (L. Koch)	P, F	OC, OL	2
Myrmecotypus lineatus (Emerton)	B	SR, IN	2
Phrurotimpus alarius (Hentz)	P	SC, MS, SW	7
P. minutus (Banks)	P, B	OC, SF, MS, OL	28
P. borealis (Emerton)	P, B	SC, SR, IN, JB, BS	9
Scotinella sp. #1	B	OC	1
Scotinella sp. #2	P	WS	1
Strotarchus piscatoria (Hentz)	B	MS	1
Totals			135
Pisauridae			1
Dolomedes okefinokensis Bishop	B, F	SC, IN, SW	3
D. albineus Hentz	B	SR	1
Pisaurina mira (Walck.)	B, F	OC, BS	5
P. undulata (Keys.)	F	BT	1
Totals			11
Anyphaenidae			1
Hibana velox (Becker)	P, B	MS, BT, BS	5
Totals			6
Ctenidae			
Ctenus captiosus Gertsch	P	OC	2
Totals			2
Heteropodidae			
Tentabunda cubana (Banks)	P, B, F	OC, SC, SF, BT, OL, BS	12
Totals			12
Thomisidae			5
Ozyptila floridana Banks	P, B	SC, MS, SR, BT, BS	47
Xysticus sp.	B, F	SC, MS, SR, IN	4
Xysticus funestus Keys.	B	SC, SR, IN	5
X. ocala Gertsch	B	BT	1
X. discursans Keys.	B	SR	2
X. ferox (Hentz)	B	MS	1
Totals			65
Philodromidae			1
Tibellus maritimus (Menge)	B	MS	1
Totals			2
Salticidae			120
Ghelna sexmaculata (Banks)	B	SC, OL	2
Habrocestum xerophilum Richman	P, B	OC, SC, SF, MS, WS, SR, BT, OL, IN, JB, BS, SW	191
Habronattus alachua Griswold	P, F	MS, SR	3
H. notialis Griswold	B	BT	2
H. trimaculatus Bryant	B	SC	1
Maevia michelsoni (Walck.)	P, B, F	BS, SW	4
Marpissa lineata (CL Koch)	P	SF	3
M. dentoides Barnes	P	SC	1
Metacyrba taeniola (Hentz)	P	SF, MS, JB	3
Neonella vinnula Gertsch	P	JB	1
Pelegrina galathea (Walck.)	B	OL	1
Phlegra fasciata (Hahn)	P, B	OC, WS, SR	3
Phidippus regius CL Koch	B	OC	1
P. cardinalis (Hentz)	B	SR	1
Totals			337
Undetermined			22

domized sampling design (Steel & Torrie 1960). Point-centered quarter methodology was used to estimate frequency, density and basal area (cross-sectional area) of trees (30 sample points, 120 trees per study area) (Mueller-Dombois & Ellenberg 1974). Twenty points were selected at random and woody plants with stems less than 2.54 cm in diameter at 1.37 m above the ground were counted in plots (3 × 2 m) to provide density and frequency of shrubs. Two sides of the shrub plots were used to delimit line transects (5 m) to measure the canopy interception (%) of grasses and herbs. Because leaf litter was generally distributed over the study sites, it was selected to represent the horizontal and vertical variation in ground-level microhabitat available to spiders. Ten plots (0.1 m^2 each) were randomly positioned in the study areas and leaf litter was collected, oven dried, and the mass determined to the nearest gram. All measurements were taken once during the second year of study.

Data analysis.—Pearson correlation coefficient was used to test hypotheses concerning the relationship between spider abundance and ground level habitat features (SAS Institute 1990). A split-plot design for repeated measures ANOVA was used to test the hypothesis that no difference existed between spider abundance, richness (number of species), seasonality, and collection year (SAS Institute 1990). Three statistical terms used by Barnes & Barnes (1955) were calculated to compare the 20 most abundant spider species. First, presence is defined as the occurrence of a species in a particular stand without reference to its abundance or frequency: Site occurrence/total no. of sites × 100. Second, density is the average number of individuals of a species per sample. Third, frequency is the number of samples out of a possible 95 samples a particular species was taken. Similarity between the communities was determined using the Jaccard index of similarity:

$$IS_j = \frac{a}{a + b + c} \times 100$$

where IS_j = Index of Similarity, a is the number of species in common between communities A and B, b is the number of species unique to community B, and c is the number of species unique to community A (Krebs 1989). The range of the index is from 0 to 100.

RESULTS AND DISCUSSION

Biodiversity of ground surface spiders (n = 5236) in sandhill communities of north and central (peninsular) Florida was represented by 23 families, 92 genera, and 154 species (Table 1).

The number of species found for particular spider families ranged from 1–25. Linyphiidae had the richest representation with 16.1% of all species collected; however, among study sites, the family constituted from 1% (WS) to 62.8% (JB) of the species found in the individual collection sites. Numerically the family accounted for 2.2% of the total spiders collected.

Lycosidae made up the largest percentage of individual spiders collected (75.2%) and ranged from a low of 62.8% (JB, BS) to a high of 87.2% (WS) among sites (Table 1). A total of 21 species was collected, ranging from a minimum of 8 (SC, WS, IN) to a maximum of 11 (SR) among sites.

Lycosidae was followed in abundance by Salticidae (6.4%), Gnaphosidae (6.3%), Clubionidae (2.6%), Linyphiidae (2.2%), Theridiidae (1.5%), Thomisidae (1.2%) and Ctenizidae (1.0%) (Table 1). Linyphiidae was represented by the greatest number of species (25) followed by Lycosidae (21) and Gnaphosidae (21), Clubionidae (16), Salticidae (14), Theridiidae (13), Araneidae (7), Thomisidae (6), and Ctenizidae (5).

Only four species were collected at all 12 sites (presence of 100%, Table 2): the lycosids *Lycosa ammophila* Wallace 1942, *Schizocosa duplex* Chamberlin 1925, *S. segregata* Gertsch & Wallace 1937, and the salticid *Habrocestum xerophilum* Richman 1981. One additional species, *Castianeira descripta* (Hentz 1847), was present at 11 sites. Eighty-three (53.9%) of the 154 species were collected at only one site (Table 1).

Of the 20 most abundant species, 7 ranked in the top 10 for density, and 9 ranked in the top 10 for frequency (Table 2). *Lycosa ammophila, Schizocosa duplex,* and *Habrocestum xerophilum* were ranked 1, 2, 3 for presence, density, and frequency, respectively. *Schizocosa segregata,* although found at all 12 sites, ranked seventh in density and frequency. *Ozyptila floridana* Banks 1895, the

Table 2.—Presence, density, and frequency values for the twenty most abundant spider species collected in the Florida abstract sandhill community.

Species	Abundance Ranking	Presence (%)	Density	Frequency (%)
Lycosa ammophila	1	100.0	16.37	86.3
Schizocosa duplex	2	100.0	7.48	54.7
Habrocestum xerophilum	3	100.0	2.01	58.9
Lycosa carolinensis	4	75.0	1.12	35.8
Sosippus floridanus	5	75.0	0.98	34.7
Arctosa littoralis	6	58.3	0.85	23.2
Schizocosa segregata	7	100.0	0.78	29.5
Zelotes pseustes	8	58.3	0.57	32.6
Ozyptila floridana	9	41.7	0.49	9.5
Drassyllus aprilinus	10	66.7	0.46	18.9
Zelotes lymnophilus	11	66.7	0.44	14.7
Castianeira descripta	12	91.7	0.41	28.4
Talanites exlineae	13	83.3	0.39	18.9
Haplodrassus signifer	13	66.7	0.39	8.4
Gladicosa pulchra	13	75.0	0.39	14.7
Phrurotimpus minutus	16	33.3	0.29	6.3
Achaearanea porteri	17	58.3	0.27	16.8
Callilepis imbecilla	18	66.7	0.25	17.9
Rabidosa punctulata	18	41.7	0.25	7.4
Agelenopsis barrowsi	20	41.7	0.24	7.4

ninth most abundant species, was present at only five of the sites and had low density (0.49) and frequency values (9.5%).

Two new state records are reported: *Centromerus tennapax* (Barrows 1940) from Orange City and O'leno State Park, and *Tapinocyba hortensis* (Emerton 1924) from Morningside Nature Center and Starkey Well Field Area.

The 12 study sites were fairly dissimilar in species composition based on the Jaccard index of similarity ($\bar{x}$ = 26.1; SD = 2.7). Spruce Creek Preserve and Interlachen were the most similar (39.6), followed by Spruce Creek Preserve and Boy Scout Reservation (38.8). San Felasco Hammock and Suwannee River State Park were the least similar (14.7) (Table 3). Corey & Taylor (1988) compared spider communities using Sorensen's index of similarity (Krebs 1989) and reported values of 0.65 (pond pine and flatwoods), 0.56 (sand pine scrub and flatwoods), and 0.51 (pond pine and sand pine scrub). Using Sorensen's index as a means of comparison, sandhill communities were dissimilar to Corey & Taylor's pond pine (0.20), sand pine scrub (0.18), and flatwoods (0.19). The high similarity values found by Corey & Taylor (1988) might have been due to the close proximity of the three communities (all within 0.80 km of each other). The closest sandhill communities studied were approximately 8.5 km apart (BS and JB; IS_j = 31.9).

Foraging guilds of spiders in the sandhill community were derived from obvious behavioral modes (modified from Corey 1988; Bultman et al. 1982; Gertsch 1979). Guilds were: 1) sit and wait ambushers: Lycosidae, Pisauridae, Ctenidae, Heteropodidae, and Thomisidae; 2) active hunters: Gnaphosidae, Clubionidae, Oonopidae, and Salticidae; 3) aerial web spinners: Theridiidae, Araneidae, and Uloboridae; 4) ground level web builders: Agelenidae, Linyphiidae, Hahniidae, and Amaurobiidae; 5) all other families. Analysis of guild composition showed that all 12 sites were basically similar (Fig. 3). The sit and wait ambushers were the dominant guild on all 12 sites. Similar results were reported by Corey & Taylor (1988), Bultman et al. (1982), and Lowrie (1948). The sandhill communities were more heavily dominated by sit and wait ambusher spiders than were pond pine, sand pine scrub, and flatwoods communities, which had a more even distribution of guilds (Corey & Taylor 1988). Lycosidae have been found

Table 3.—Jaccard Index of Similarity for spider species collected in sandhill study sites of Florida. See text for site abbreviations.

	Collection Site										
	SC	SF	MS	WS	SR	BT	OL	IN	JB	BS	SW
OC	22.6	25.0	23.9	27.5	22.9	24.6	26.7	28.8	25.0	26.4	21.8
SC		19.0	21.9	21.2	23.5	25.9	20.0	39.6	25.9	38.8	23.1
SF			27.1	29.5	14.7	26.5	25.5	29.8	24.5	30.4	20.8
MS				22.8	22.7	31.6	26.6	29.3	31.0	25.0	37.7
WS					22.0	28.9	30.0	30.2	19.6	23.9	24.4
SR						19.4	17.6	28.3	21.9	23.4	18.6
BT							22.8	24.0	17.0	34.8	32.6
OL								19.6	24.5	18.6	24.1
IN									24.5	35.6	28.9
JB										31.9	27.7
BS											27.7

to occur in communities with little litter accumulation (Bultman et al. 1982), whereas thomisids and ground-level web builders (Agelenidae, Linyphiidae, and Hahniidae) increase in dominance as litter increases (Uetz 1979).

Pearson correlation coefficient was used to test the relationship between the abundance of the eight most common spider families collected and ground-level habitat features (SAS Institute 1990) (Table 4). The number of species and of individual spiders was not significantly correlated to any habitat feature ($P > 0.05$). Other studies have found correlations

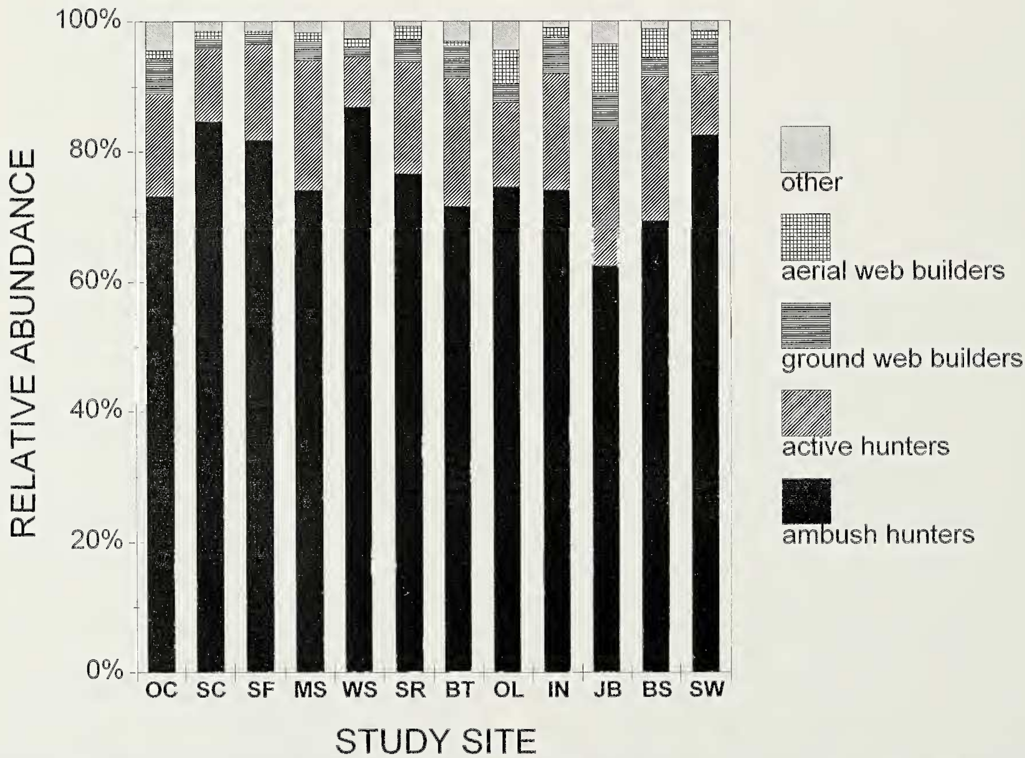

Figure 3.—Spider guild composition for 12 Florida sandhill study sites. See Figure 2 for site abbreviations.

Table 4.—Correlation (r) of the eight most common spider families abundance with ground level habitat features in Florida sandhills. + = for the entire sandhill population. * = r value significant at P < 0.05.

Family	Shrub density (No./m²)	Grass-herb ground cover (cm)	Mass of plant litter (g)	Tree basal area (cm²)
Lycosidae	−0.287	−0.001	0.079	−0.132
Thomisidae	0.660*	−0.013	−0.170	0.313
Linyphiidae	−0.166	0.241	0.088	−0.034
Gnaphosidae	0.172	−0.432	0.087	0.331
Clubionidae	0.264	−0.029	0.401	0.531
Theridiidae	0.522	0.190	−0.426	0.041
Salticidae	0.518	−0.201	0.106	0.689*
Ctenizidae	−0.229	0.447	−0.343	−0.680*
No. of species+	−0.272	−0.166	−0.110	−0.047
No. individuals+	0.488	0.069	0.039	0.452

between spider abundance and an increase in litter (Hagstrum 1970; Lowrie 1948). Thomisidae abundance was found to be significantly correlated ($P < 0.05$) to shrub density, and Salticidae abundance was significantly correlated to basal area of trees in the study sites. In contrast, Ctenizidae were significantly reduced in abundance on study sites with a high basal area of trees. Spider abundance in general was unrelated to or reduced by increased grass-herb ground cover (negative correlations in 6 of 10 comparisons, Table 4). These results suggest that the abundance of certain spider families is affected by the amount of incident sunlight received. Sites with a larger tree basal area would have more canopy cover and therefore create more shade than habitats with low basal areas.

Spider abundance ($F_{1,22} = 2.56$, $P > 0.124$) and the number of species ($F_{1,22} = 0.00$, $P > 0.952$) were not significantly different between the first and second years of collecting (Fig. 4). Based on the combined years, an analysis of split-plot design ANOVA (SAS Institute 1990) suggested that spider abundance ($F_{3,66} = 6.17$, $P < 0.0009$) was significantly different among the four seasonal periods for the total sandhill population. Scheffe's test (a = 0.05) showed that winter, spring, and summer were not significantly different in total number of spiders caught. Likewise, fall and winter were not significantly different, but fall was significantly different from spring and summer. The number of species was also significantly different ($F_{3,66} = 11.87$, $P < 0.0001$) among the four seasons. Scheffe's test showed that spider populations in the fall were significantly different from spring and summer, and winter populations were significantly different from spring ($P < 0.05$). Other seasonal comparisons were not significantly different ($P > 0.05$).

Difference in the seasonal abundance of spiders was expected due to the variation in patterns of activity and mortality affecting adults and the appearance of juveniles. Indeed, variation in abundance of individual species between years one and two often accounted for observed seasonal differences at the study sites (Fig. 4).

Species observed to vary greatly from year to year at one site include: *Arctosa incerta* Bryant 1934, *Lycosa ammophila, Ozyptila floridana, Schizocosa duplex, Sosippus floridanus* Simon 1898, and *Zelotes pseustes* Chamberlin 1922. Some of the variation of *L. ammophila* (at SC and SW) was due to the capture of females with young (170 and 102, respectively).

Study sites appeared to be very similar in terms of soils, relief, drainage, and vegetal cover (Stout & Corey pers. obs.). Although guild structure was similar from site to site, the species composition of ground surface spiders showed a great deal of site variation. The substantial dissimilarity in the species composition of spiders from place to place in the remaining sandhill habitats suggests that conservation of spiders and, by inference, other invertebrate taxa of the ground surface fauna,

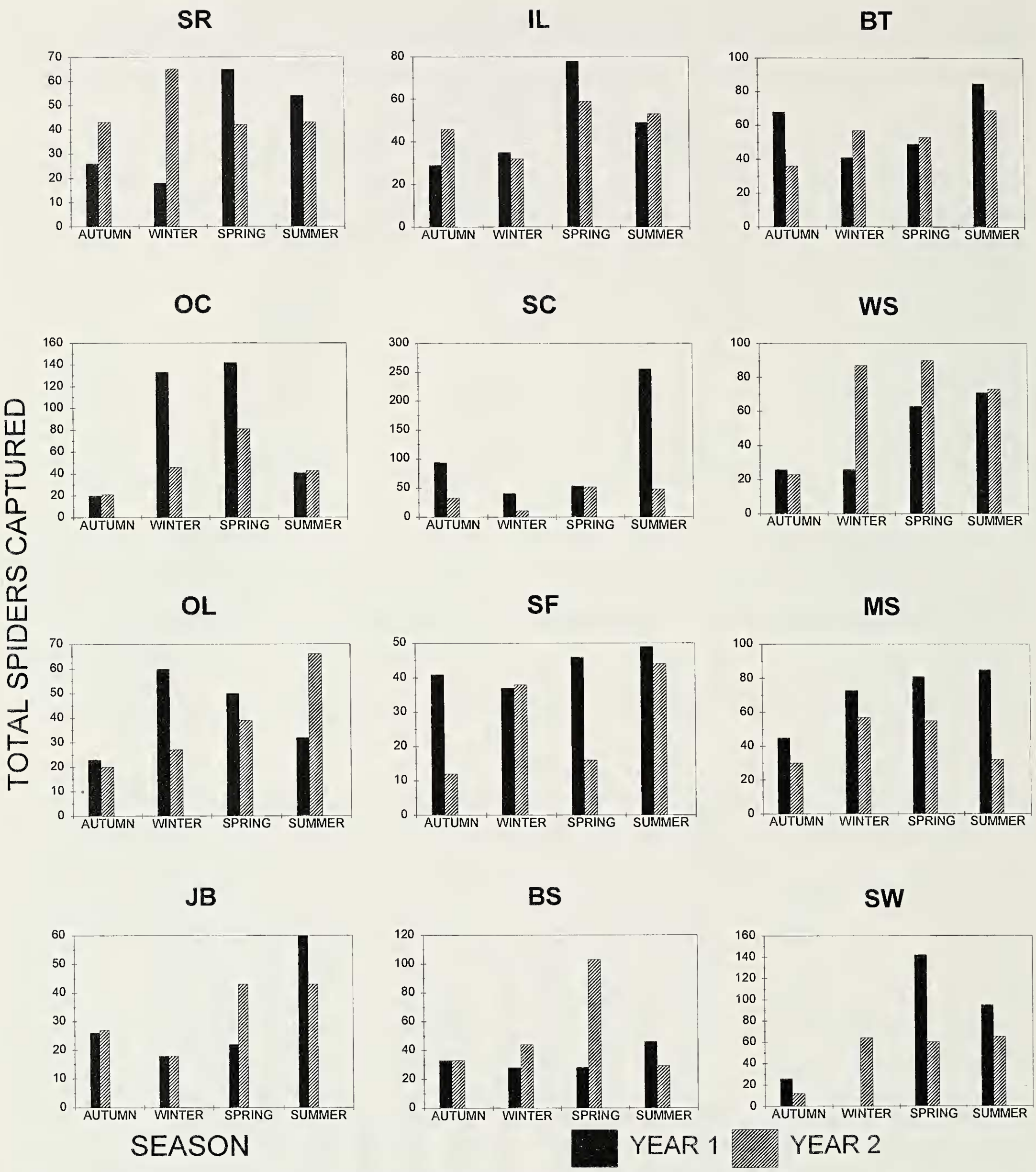

Figure 4.—Spider seasonal abundance in 12 Florida sandhill study sites. See Figure 2 for site abbreviations.

will require many sites to be preserved as opposed to a few larger sites (Main 1987).

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